SiD's Homework for the Detector Concept Report

SiD Concept Workshop
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John Jaros

What's the ***DCR***?

- Companion document to GDE's Reference Design Report (RDR) which outlines baseline and costs for the ILC machine.
- DCR has two sections: Physics (50p)+Detector(150p)
- RDR and DCR are due end of 2006
- Detector DCR will
  - make the case that detectors can do the ILC physics
  - overview the different detector concepts
  - review status of subsystem R&D
  - document detector performance
  - ballpark detector cost
  - argue for 2 detectors and 2 IRs

More about the DCR

- Detector Outline Documents provide much of the material for the Detector DCR

- WWS-OC oversees writing DCR

  Editorial Board

  Brau, Richard, Yamamoto, eds

  Physics Case for ILC

  J. Lykken, M. Oreglia, K. Moenig, A. Djouadi, S. Yamashita, Y. Okada

  ILC Detectors and Costs

  A. Miyamoto, T. Behnke, J. Jaros, C. Damerell

- Spirit of DCR

  cooperative among concepts, not a vs b vs c vs d

  make a compelling case for ILC physics and detectors

The Outline of the DCR

A. Miyamoto's Talk

1. General Introduction
2. Challenges for Detector Design and Technology
3. Introduction to the Detector Concepts
4. MDI Issues
5. Subsystem Designs and Technologies
6. Sub-Detector Performance
7. Integrated Physics Performance
8. Why We need 2IRs and 2 Detectors
9. Detector Costs
10. Future Options
11. Next Step
12. Conclusion

More Work Needed

- Detector Performance Required
  Really need 30%/√E jet energy resolution? Why?
  Really need 0.1% X_0 /layer vertex detector? Prove it!
  Really need $\Delta p/p^2 = 5 \times 10^{-5}$ in the tracker?
  Much of the HEP community thinks a LEP detector will do. We need to demonstrate otherwise.
  We have a good start, but need to bring studies to conclusion, resolve discrepancies.

- What is real subdetector performance?
  Realistic (=full MC studies) tracking pat rec efficiency with full machine and physics backgrounds.
  Realistic PFA performance—at all energies, in multijet events
  Realistic vertex detector performance

- Full MC Physics Analyses. How best to argue that detectors can do the physics?

DCR Homework = SiD Homework

- Much of the work required for the DCR is just what SiD needs to be doing anyway, e.g., understanding Sub-Detector Performance Goals:

  Evaluating sub-detector performance in full MC
  (Developing the tools to do so is just what we
  need to move on to design optimization studies)

- DCR will showcase relevant SiD Studies (ditto for LDC, GLD, 4th). Good PR.

  Tracking Group dream: Full G4 simulation, including detector response, digitization, cluster finding, hit position determination. Pattern recognition studies in the presence of machine and physics backgrounds, accounting for ILC bunch structure.

  Cal Group dream: Full PFA code, ready to use in jet environment.

What SiD Needs

- More Simulation/Analysis Manpower
  - Benchmarking group
  - Tracking Performance Studies
  - PFA Development, Studies
  - Detector Optimization

  How? Lab RAs? Halftime RAs from R&D groups? Redirected Lab staff?
- Coordinated Studies
  - Progress is slow when motion is Brownian
  - Fewer cowboys, more Posses

  How?

What's a Detector Outline?

WWS Pass 1:

"SUGGESTED FORMAT OF DETECTOR OUTLINES The page counts suggested are approximate, provided to give guidance on the level of detail requested.

1. An introduction to the detector concept 8-12 pages
2. A description of the detector 25-35 pages
3. Expected performance 10-20 pages
4. Subsystem technology selections and/or options 10-20 pages
5. Status of ongoing studies 10-20 pages
6. List of R&D needed 5-10 pages
7. Cost estimate 8-12 pages
8. Conclusion 4-8 pages

TOTAL 80-137 pages (guidance)"

What can the Detector Outline Do for SiD?

- Fully Define the Starting Point. *We will learn a lot by writing it down.*
- Substantiate Performance Claims and Answer Historical Objections. *We're right; they're wrong; we'll prove it.*
- Flesh out the mechanics. *Pre-engineering designs.*
- Review technology choices. *Define SiD's R&D path.*
- Push the selling points: robust, sensitive to single bx, performant, integrated, cost conscious. *Why SiD is the right choice.*
- Describe how we'll optimize SiD. *How we get to the CDR.*

Detector Outline outline and editors

I. Introduction to SiD (**Aihara/Brau**) 1
- A. The ILC Physics Menu
- B. The ILC Environment
- C. SiD Rationale
- D. SiD Starting Point, Integrated Performance, and the Optimization Process
- E. Purpose of this document: SiD Snapshot on Road to CDR
- F. Executive Summary

II. Physics, Environment, and Costs Drive the Detector Design (**Jaros/Karyotakis**)
- A. Subsystem Performance Required by the Physics (subsystem benchmarks)
- B. ILC Environmental Concerns
  1. Expected Backgrounds and Occupancies and Radiation Damage
  2. Detector Livetime, event cleanliness, pattern recognition capability
  3. Unexpected backgrounds and Robustness
  4. EMI
- C. Cost Overview: Tools and Optimization

Outline and editors

III. The SiD Detector (**Weerts**)

A. Global Issues (**Burrows, Tauchi**)

1. Overview of Detector (Footprint, Space Requirements, Access)
2. MDI. Crossing Angle, Beamline Design, Masking

B. Detector Subsystems

(Full specification, mechanical concept, readout concept, subsystem performance required, subsystem performance as designed, detector technologies, R&D needed, alignment and calibration, algorithm and code development and design tools, detector response simulation, how to optimize/what's next)

1. Tracking Systems (Vertex, Barrel, Forward, Ecal) (**Demarteau, Partridge, Su Dong**)
2. Calorimetry (PFAs, Ecal, Hcal) (**Frey, Repond**)
3. Lumcal, Beamcal (?)
4. Solenoid, DID, and Flux Return (**Smith, Krempetz**)
5. Muon System (**Band, Fisk**)
6. Energy and Polarization (?)

C. Electronics and DAQ **(Breidenbach**)

Outline and editors

IV. Integrated Physics Performance and Benchmarking (**Graf, Barklow**)
- A. Simulation of SiD. Level of detail. Backgrounds.
- B. Benchmark Reactions
- C. Performance of SiD
- D. Status of studies, outstanding design questions, and design strategy

V. SiD R&D Needs (**White**)
- A. R&D Issues
- B. Schedule for answering Issues
- C. Beam Tests needed

VI. Costs **(Breidenbach**)
- A. Model Assumptions
- B. Cost Drivers and SiD Variants

VII. Conclusions and Next Steps (**Aihara, Jaros, Karyotakis, Weerts**)

Comments

- The core of the Detector Outline is the full description of the subsystems. That material gets reworked in the introductory and concluding sections. It is critically important, and needed soon.
- Involve your subgroup in this process as much as possible. Invite new people to participate, serve as readers and editors as well as contributors, and potential document signers.
- We need to adhere to a schedule to produce a high quality document in time for Bangalore.
  A proposal: First Drafts due Feb. 3
  First Edits due Feb. 10
  Second Drafts due Feb. 24
  Final Draft complete Mar. 3